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(54) **LINE GENERATING DEVICE**

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Primary Examiner—Christopher W. Fulton

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(65) **Prior Publication Data**

(57) **ABSTRACT**

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Related U.S. Application Data

(60) Provisional application No. 60/469,160, filed on May 9,
2003, and provisional application No. 60/466,685, filed on
Apr. 30, 2003.

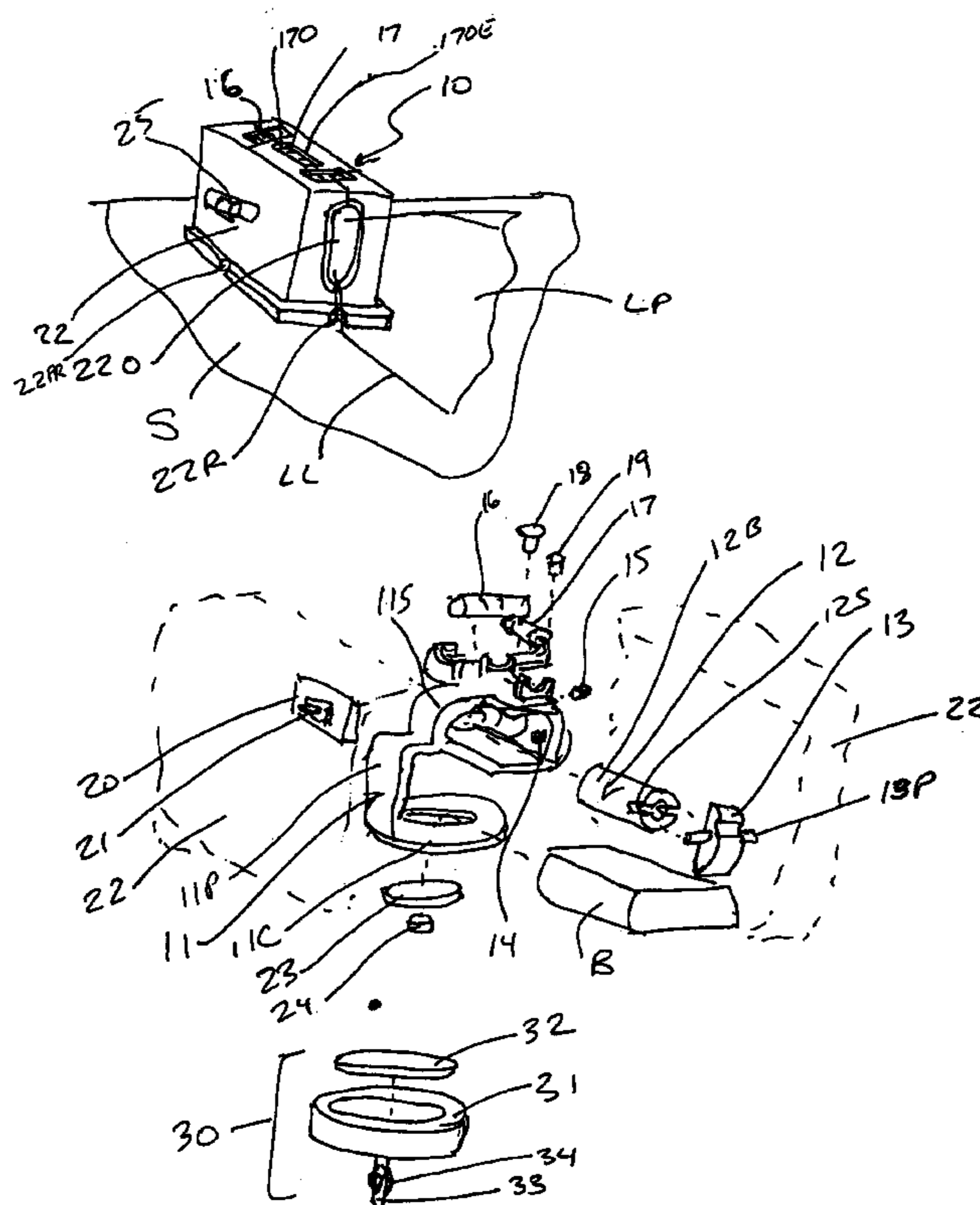
A line generating device may include a housing, a support
assembly mounted within the housing, a light source
mounted on the support assembly, a lens mounted on at least
one of the support assembly and the light source, the lens
receiving light and projecting the light in the shape of a fan
within a plane, and a first level vial mounted on the support
assembly, wherein the first level vial is coplanar or perpen-
dicular to the plane. The device may also include a magnet
mounted on the support assembly.

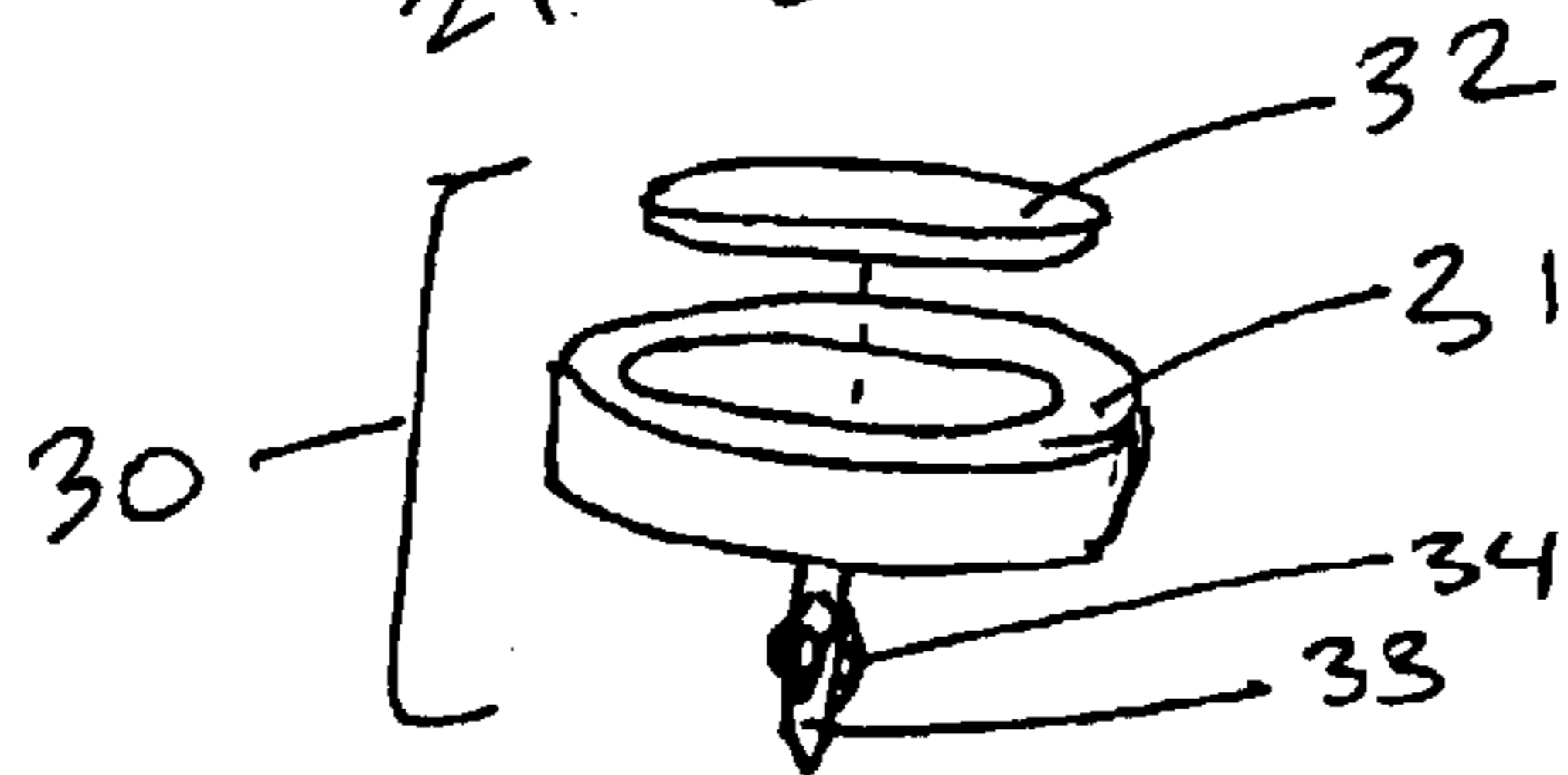
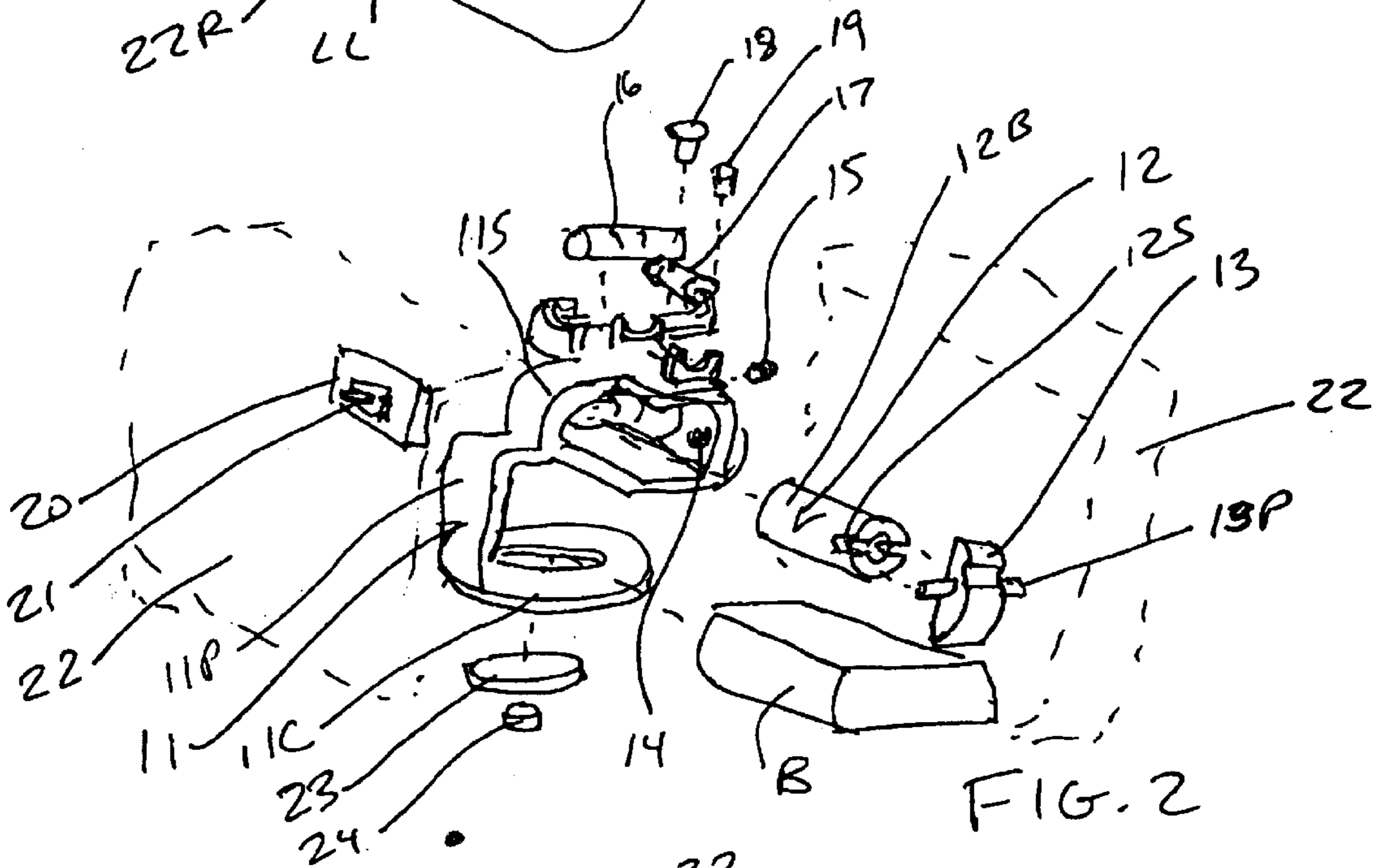
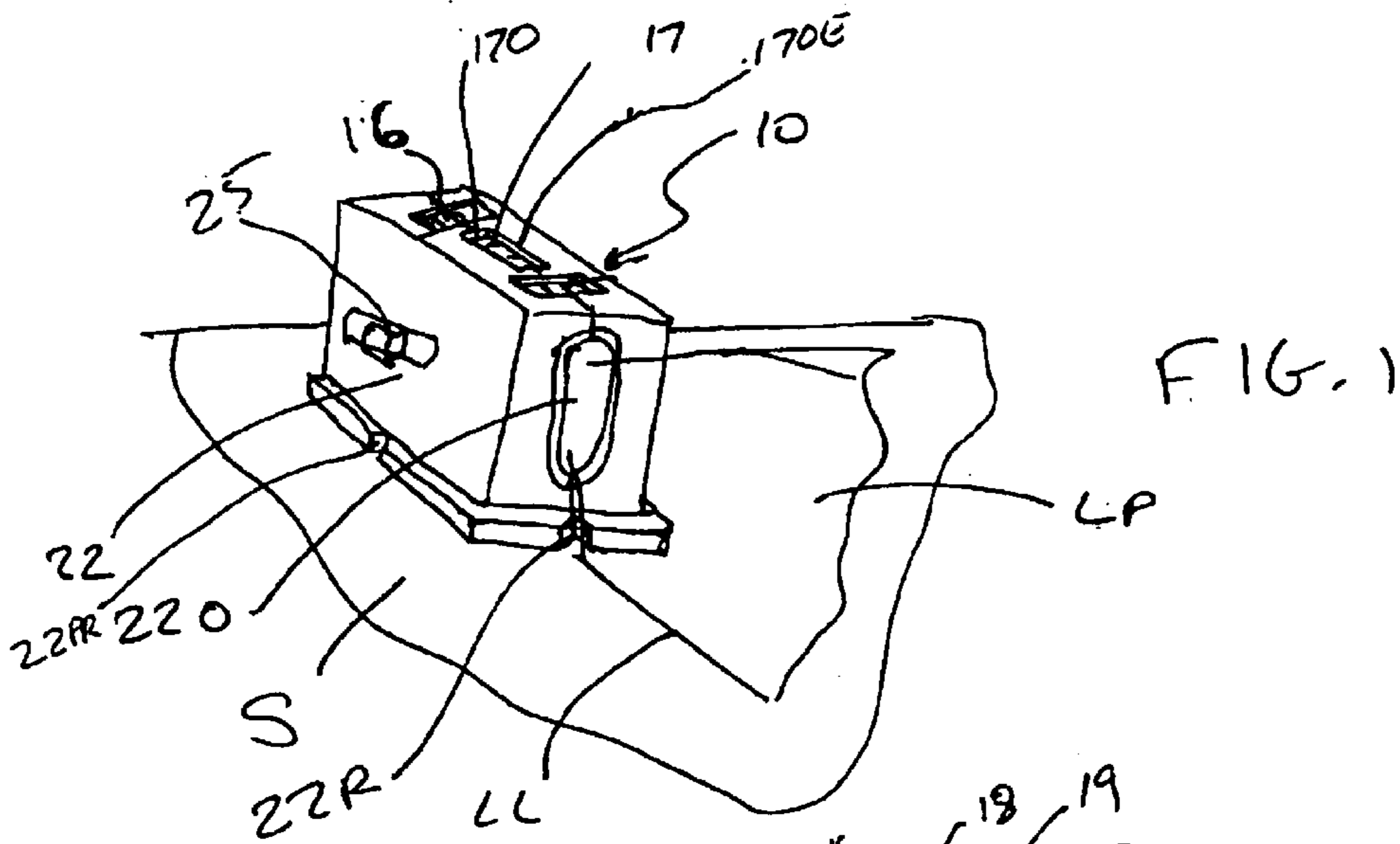
(51) **Int. Cl.**⁷ **G01C 15/02**; G01B 11/26

(52) **U.S. Cl.** **33/286**; 33/370; 248/222.52

(58) **Field of Search** 33/286, 227, 281,
33/282, 283, 285, 347, 370, DIG. 21, 451;
248/682, 220.21, 222.13, 222.52, 223.41,
224.51, 224.61

20 Claims, 3 Drawing Sheets





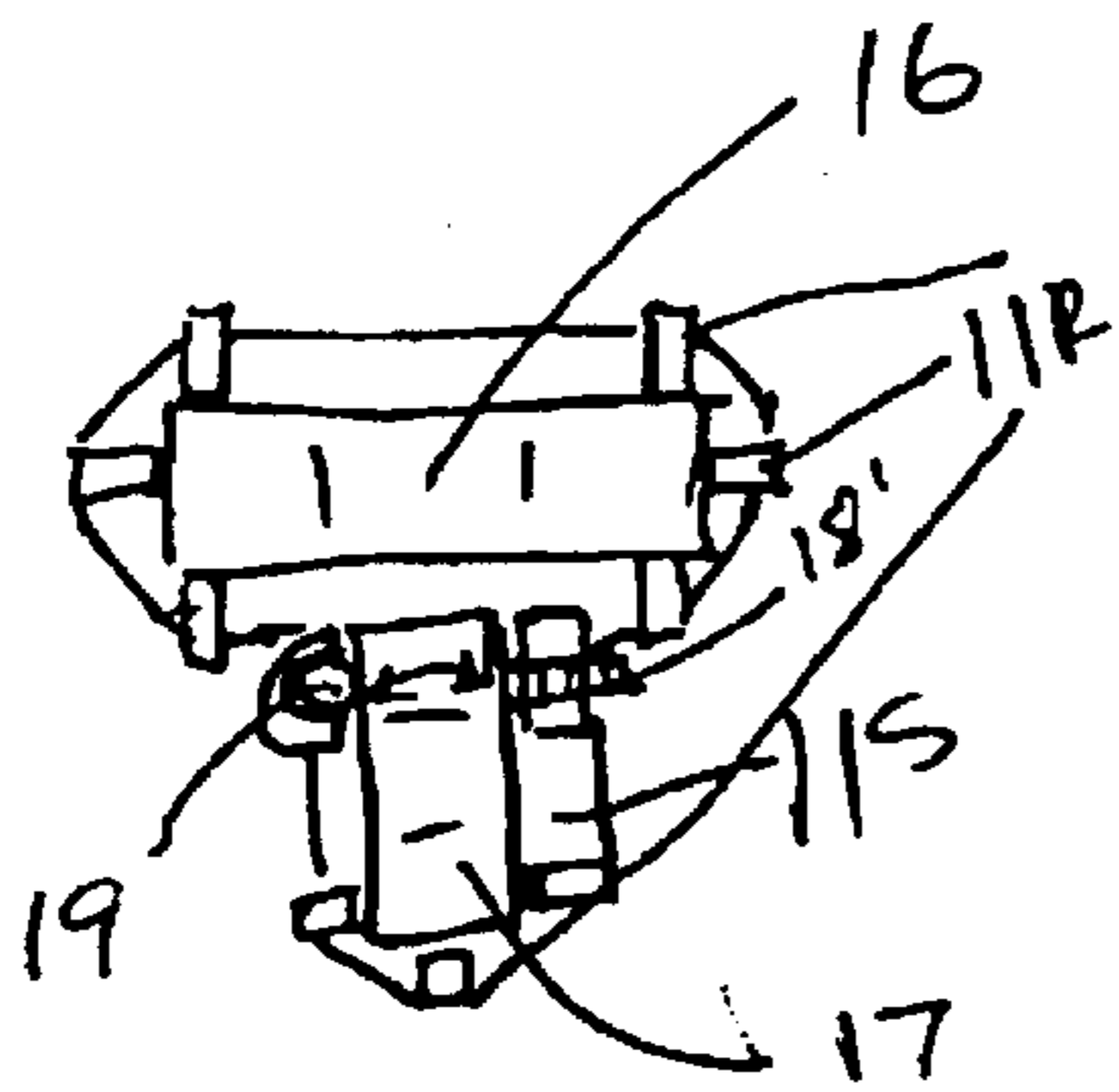
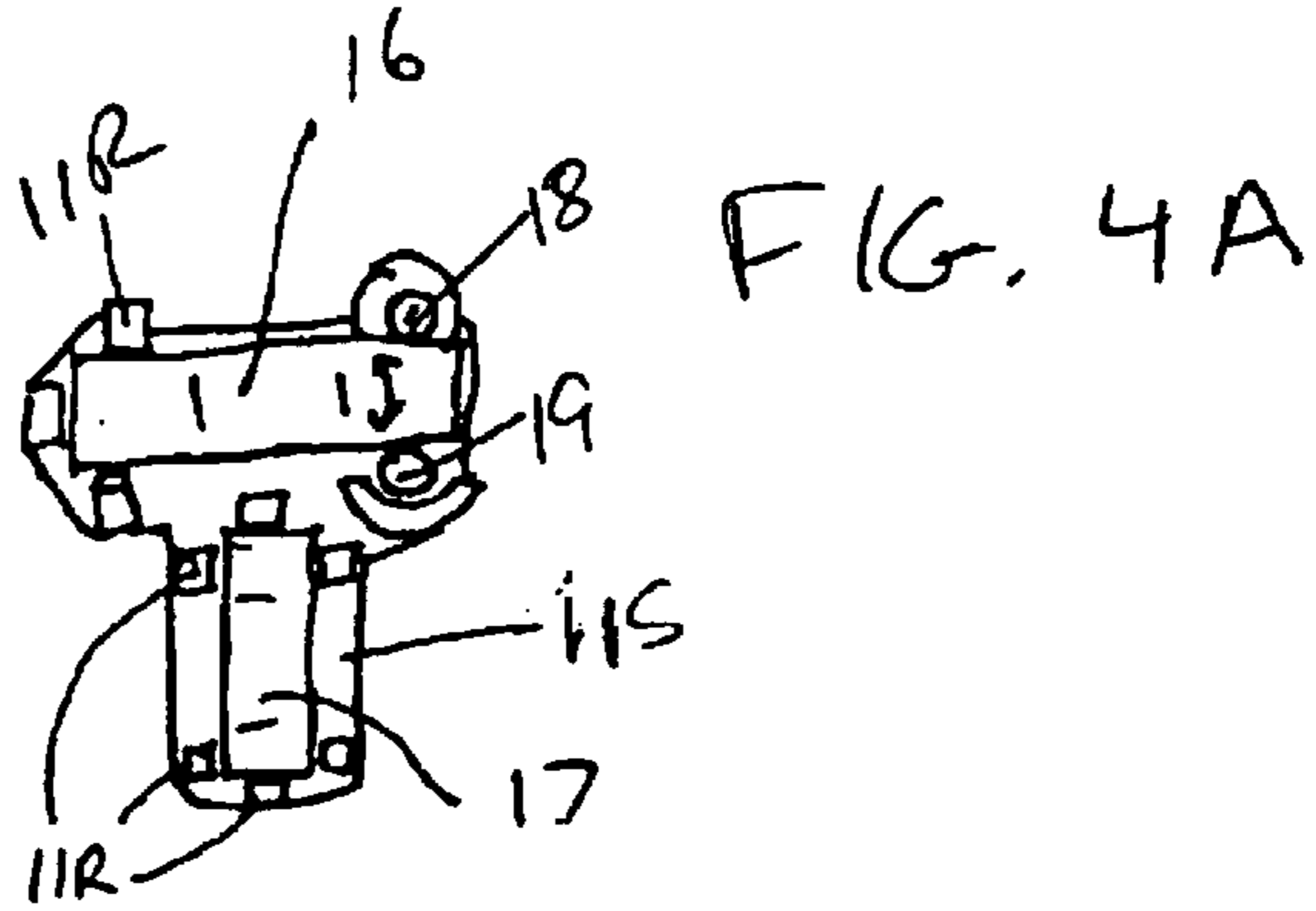
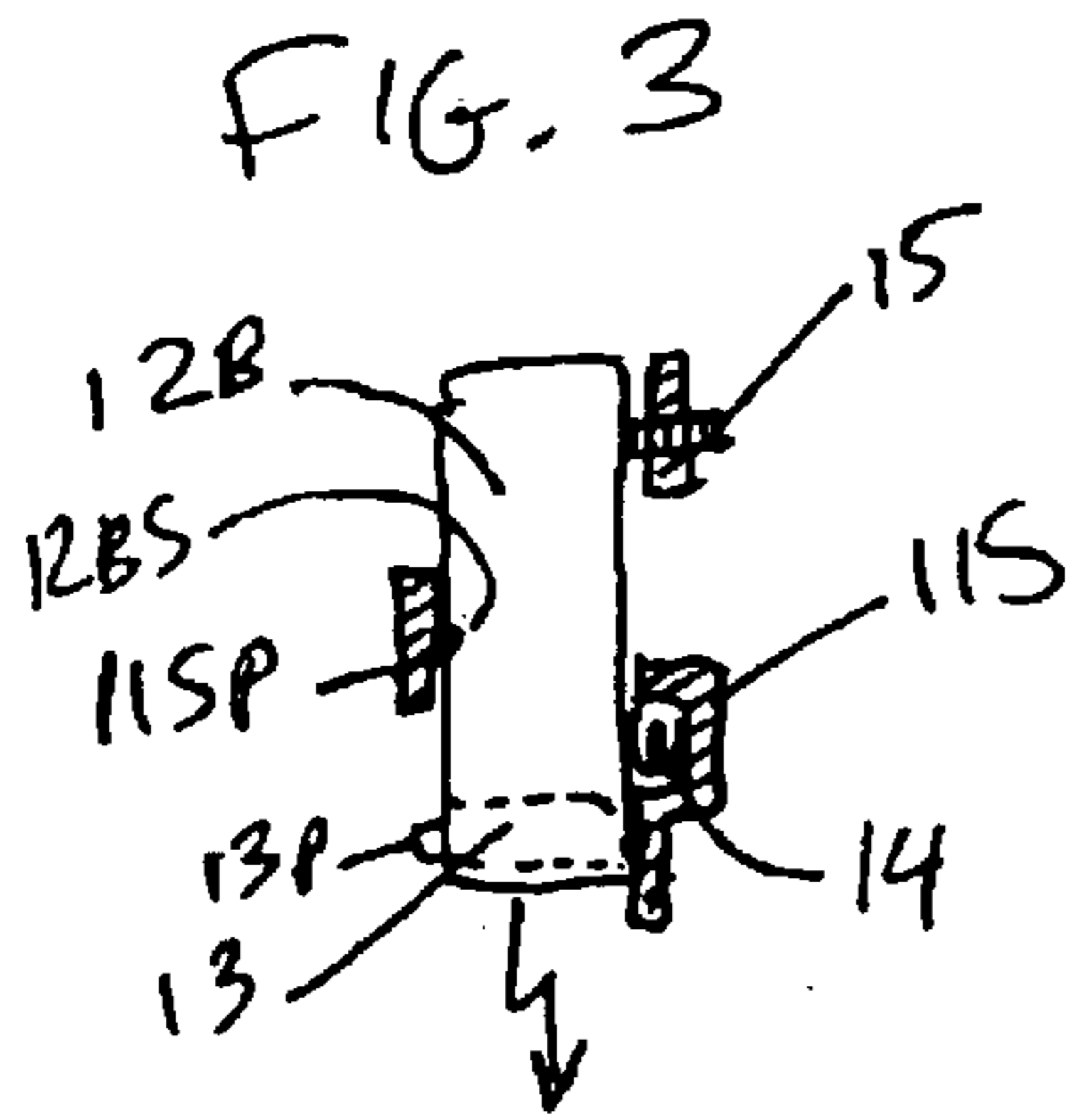


FIG. 4B

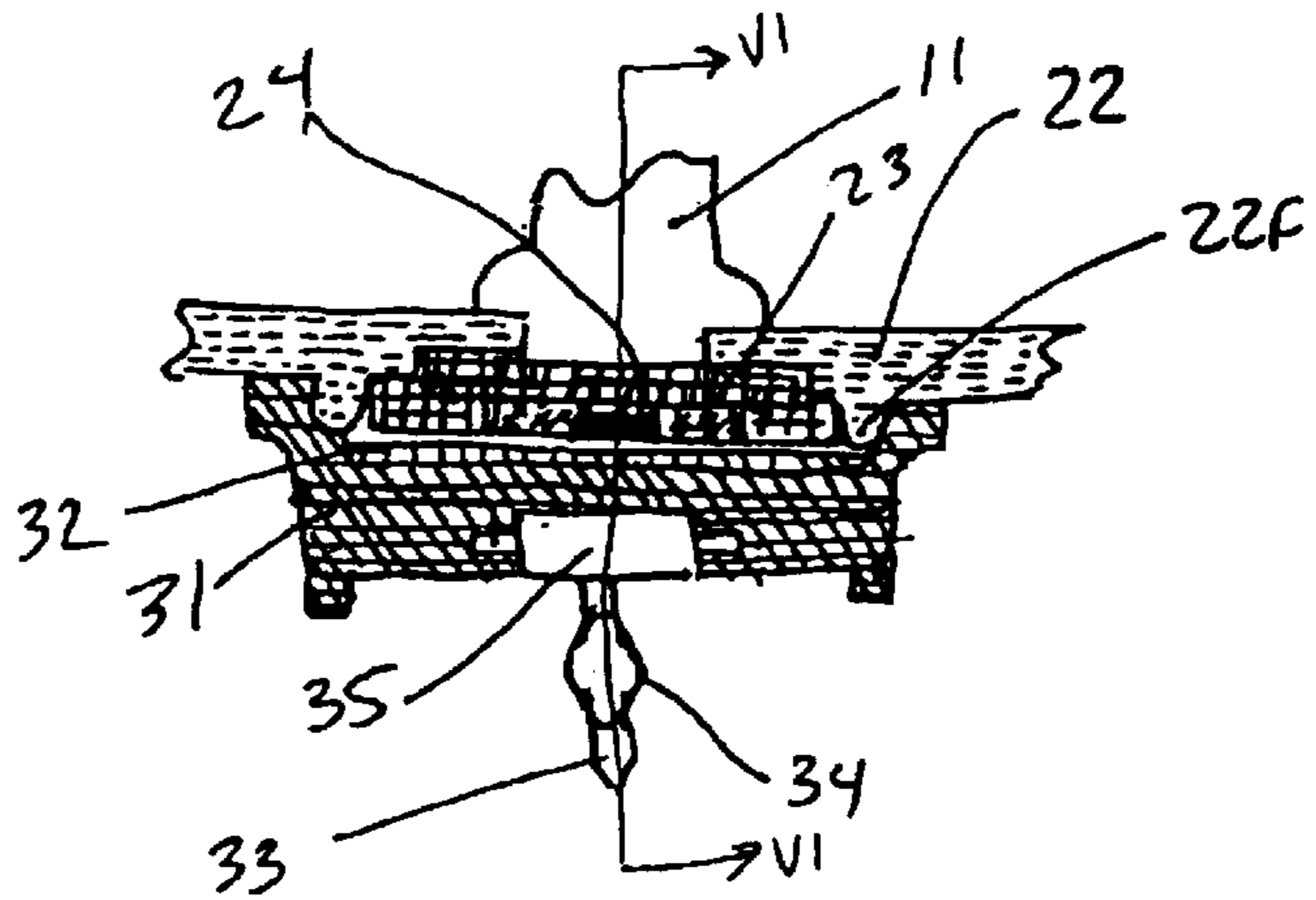


FIG. 5

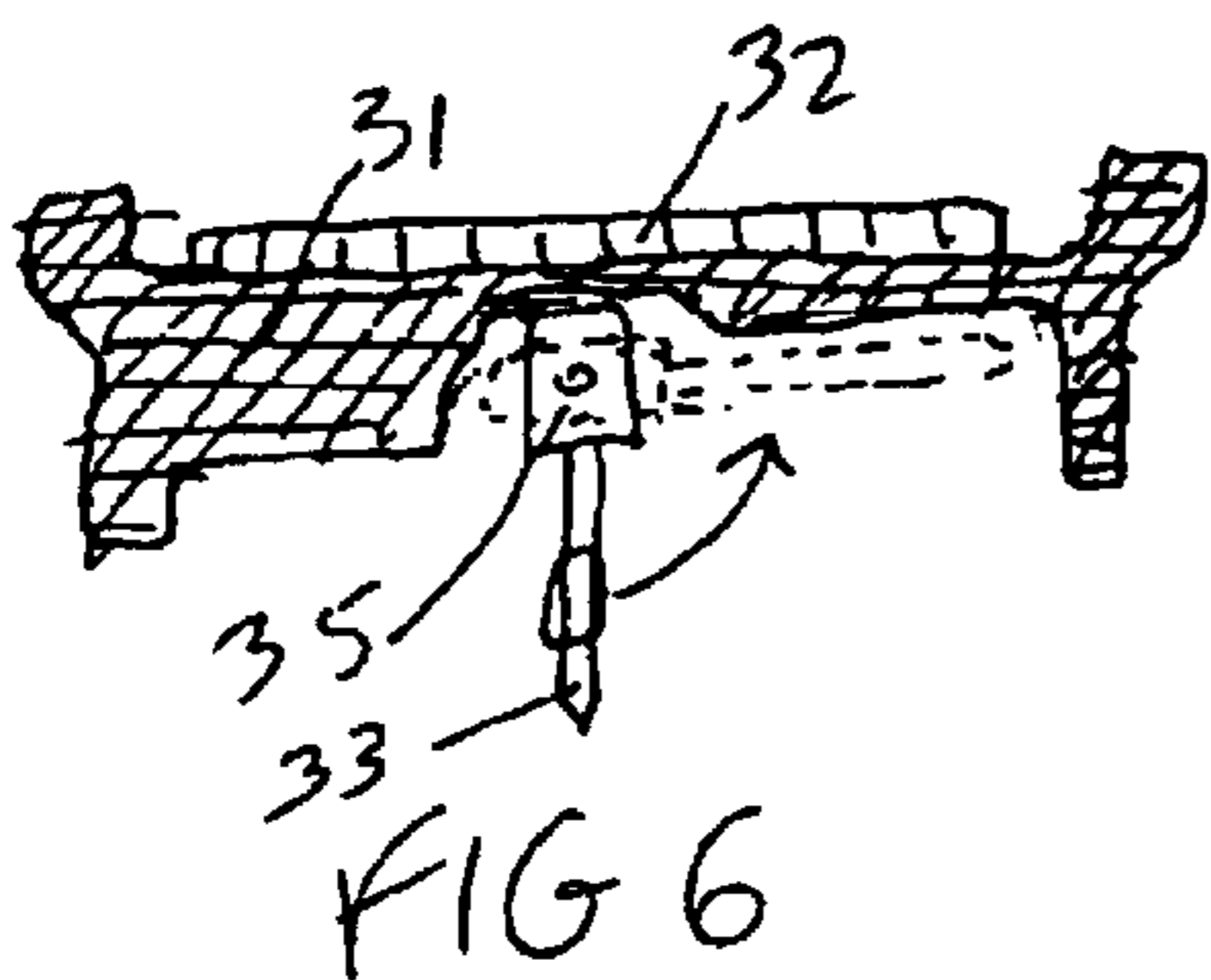
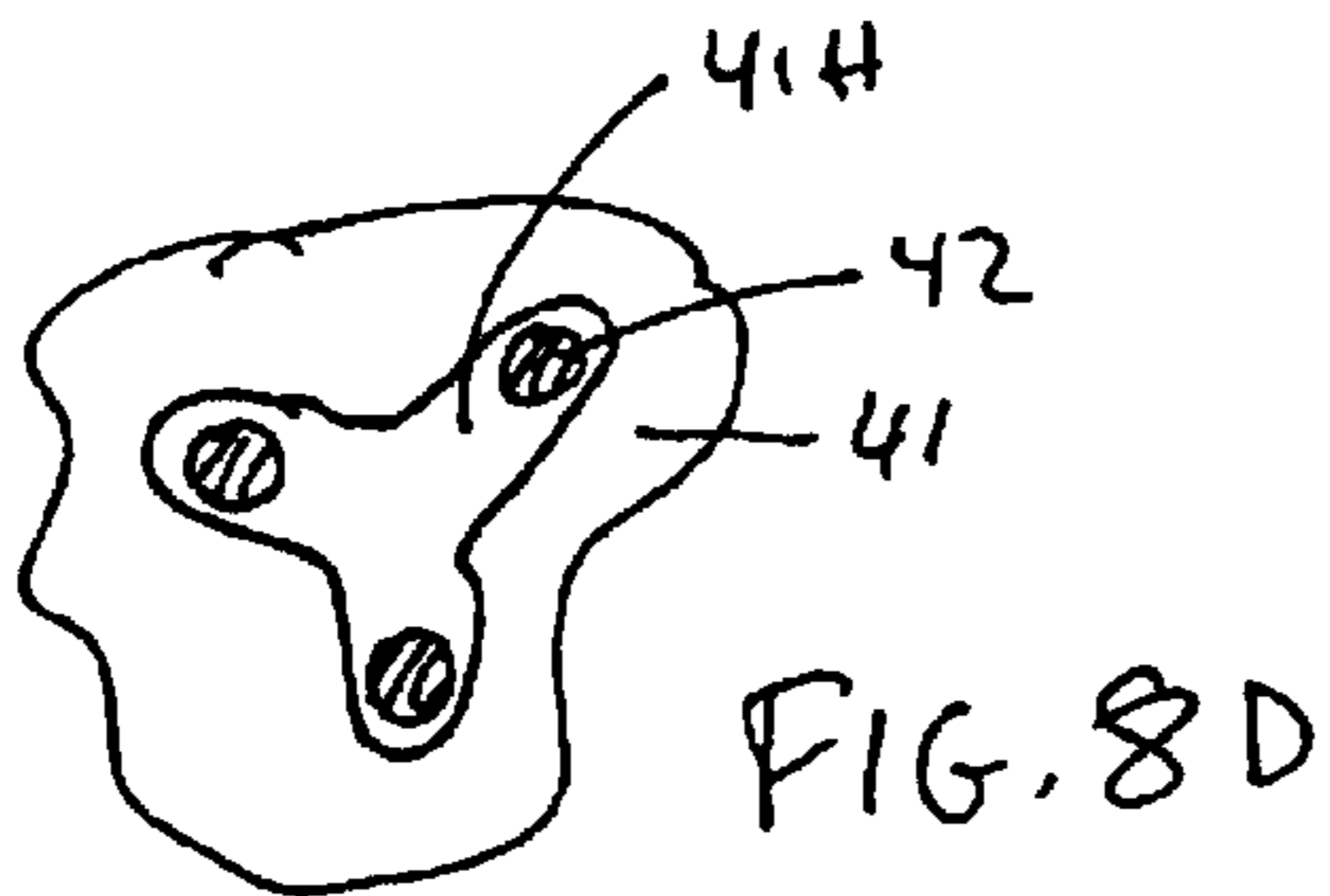
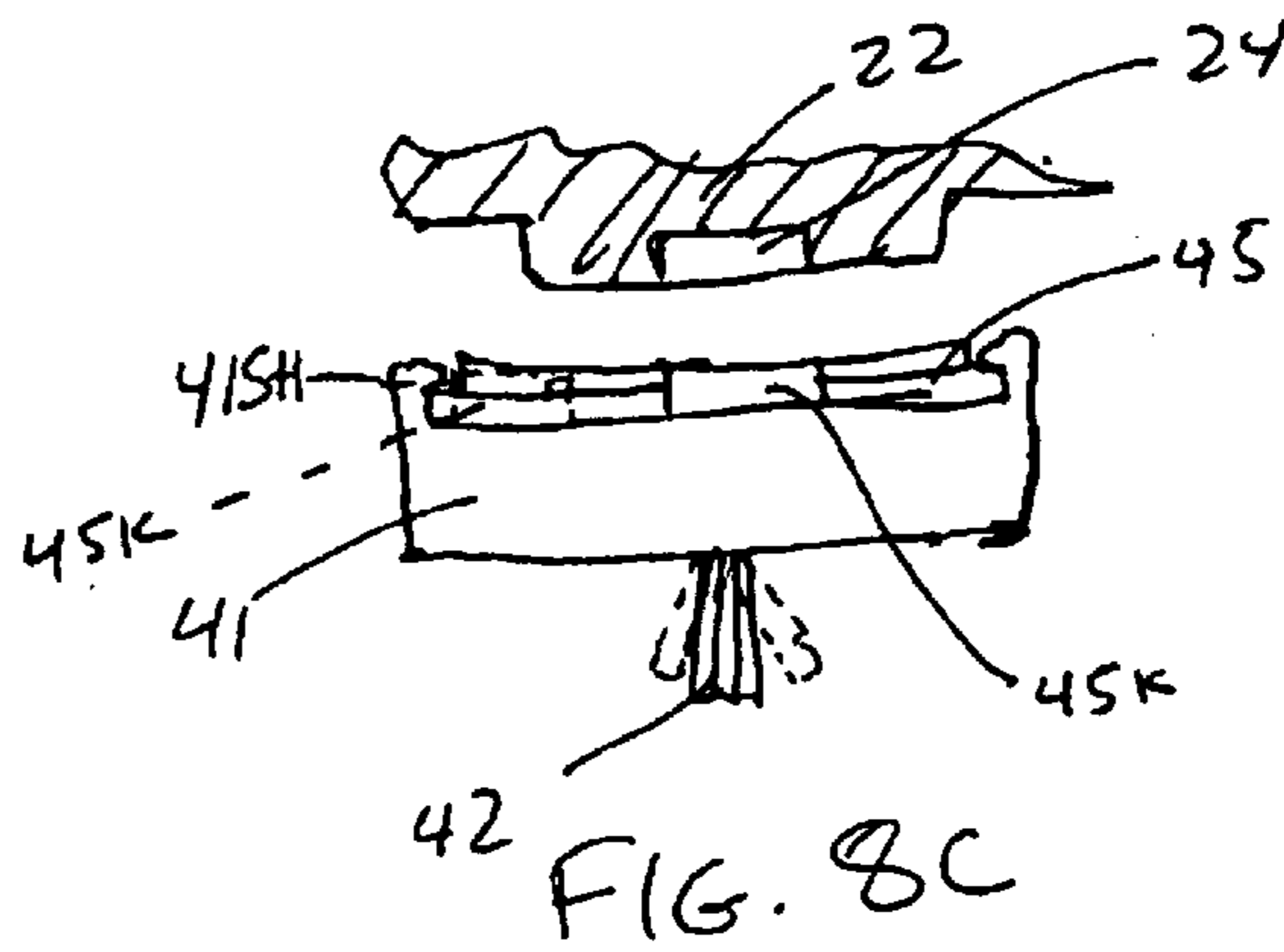
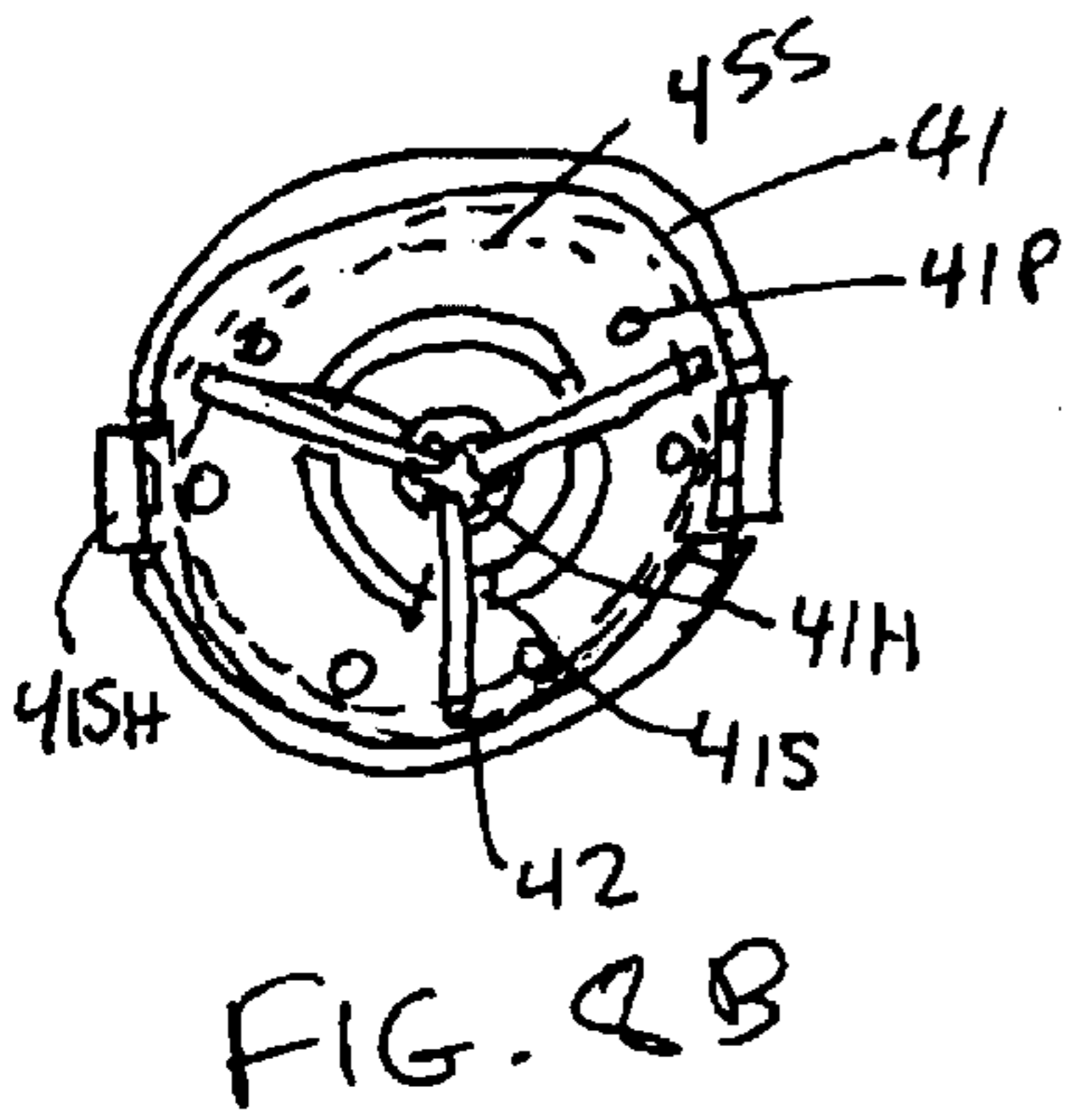
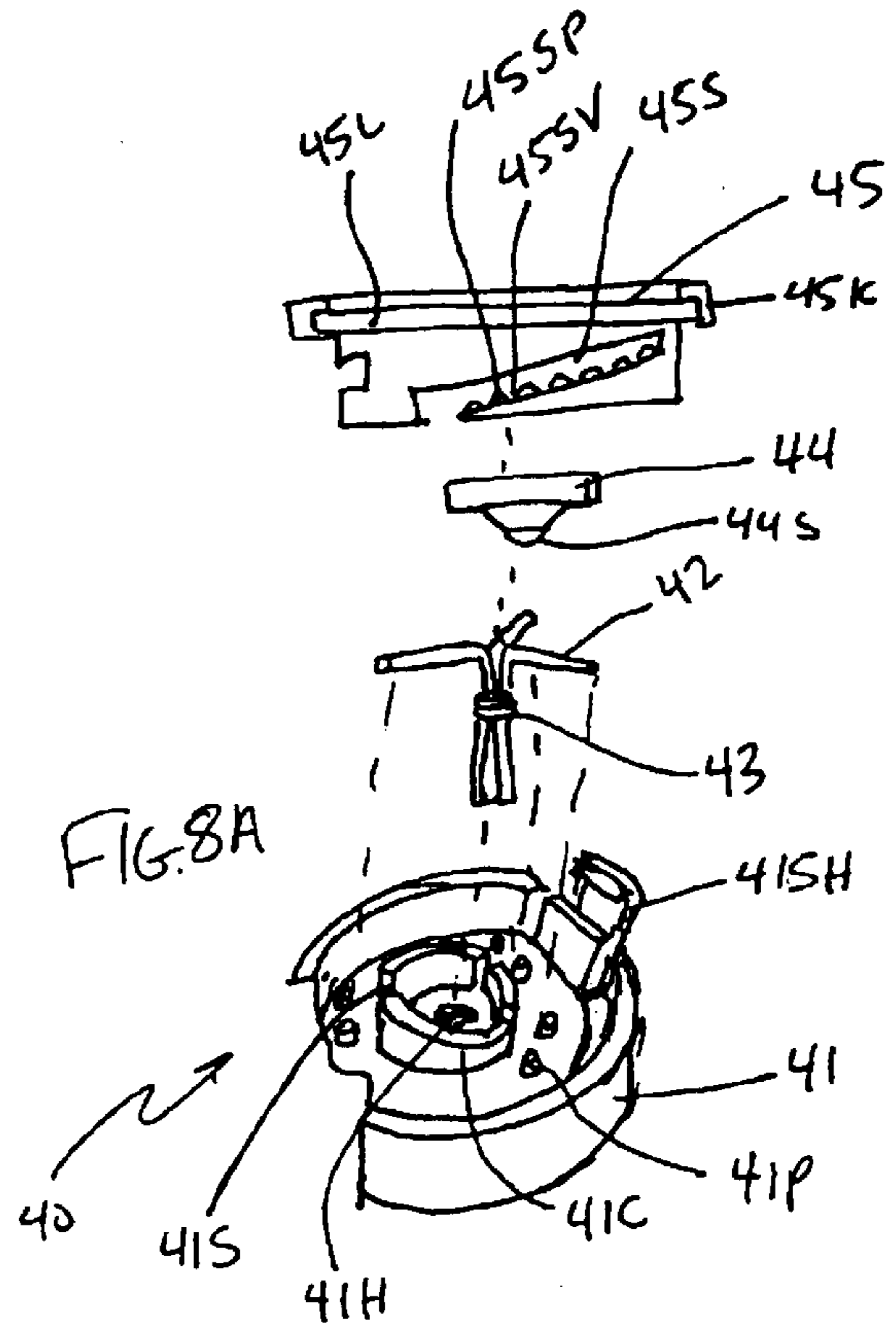
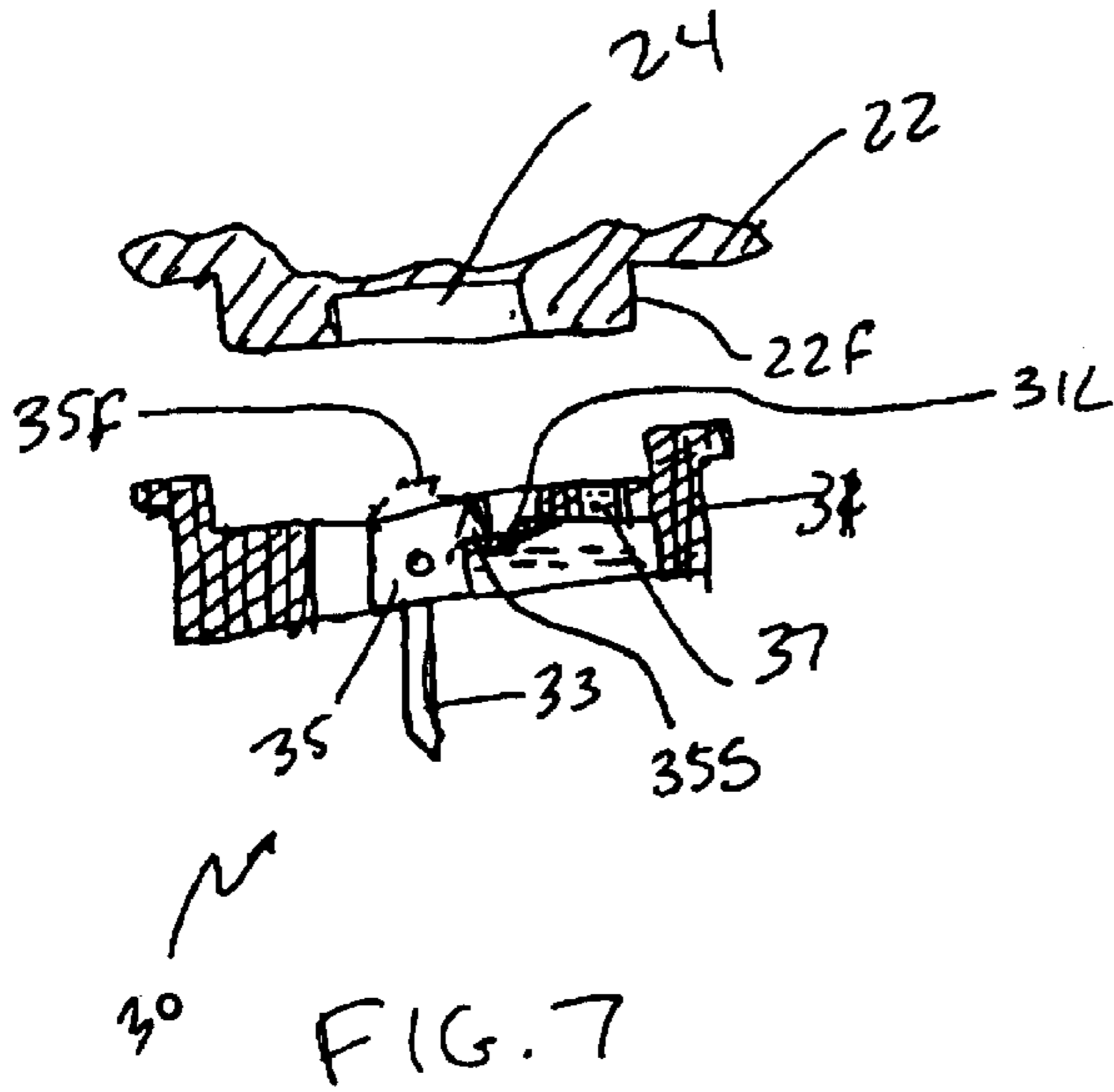


FIG. 6



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LINE GENERATING DEVICE
CROSS-REFERENCE TO RELATED APPLICATIONS

The present application derives priority from U.S. application Ser. No. 60/469,160, filed on May 9, 2003, now pending, and U.S. application Ser. No. 60/466,685, filed on Apr. 30, 2003, now pending.

FIELD OF THE INVENTION

The present invention generally relates to line generating devices and more specifically to laser line generating devices.

BACKGROUND OF THE INVENTION

In the construction industry, it is well known to use laser levels for marking reference lines to be used in the layout of different features in a room or structure. Most of these laser levels are expensive due to the optics and electronics involved therein. Accordingly, it is an object of the invention to provide a line generating device that is less expensive to manufacture than the prior art laser levels.

SUMMARY OF THE INVENTION

In accordance with the present invention, an improved line generating device is employed. The line generating device may include a housing, a support assembly mounted within the housing, a light source mounted on the support assembly, a lens mounted on at least one of the support assembly and the light source, the lens receiving light and projecting the light in the shape of a fan within a plane, and a first level vial mounted on the support assembly, wherein the first level vial is coplanar or perpendicular to the plane.

Additional features and benefits of the present invention are described, and will be apparent from, the accompanying drawings and the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate preferred embodiments of the invention according to the practical application of the principles thereof, and in which:

FIG. 1 is a perspective view of line generating device constructed in accordance with the teachings of the present invention;

FIG. 2 is an exploded perspective view of the line-generating device of FIG. 1;

FIG. 3 is a partial cross section illustrating the adjustment means for adjusting the laser barrel;

FIG. 4 illustrates different means for adjusting one of the level vials disposed on the frame assembly; whereas FIGS. 4A–4B are the first and second embodiments, respectively;

FIG. 5 is a partial cross section showing the line-generating device in combination with the pin assembly;

FIG. 6 is a cross-section of the pin assembly along line VI—VI of FIG. 5;

FIG. 7 is a cross-section of an alternate embodiment of the pin assembly; and

FIG. 8 illustrates a wall mounting assembly, where FIGS. 8A–8C are exploded, partial top plan and side views, respectively, and FIG. 8D is an enlarged top plan view of the hole in the assembly.

DETAILED DESCRIPTION

With reference to FIGS. 1 and 2, a line-generating device constructed in accordance with the teachings of the present

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invention is generally indicated by reference numeral 10. Line generating device 10 may comprise a frame assembly 11, a diode assembly 12, a lens 13 mounted onto the diode barrel 12, level vials 16, 17 mounted on frame assembly 11, printed circuit board 20, with a switch 21 mounted thereon, battery B received on the frame assembly 11, a switch actuator 25 for actuating switch 21, and a housing 22 for receiving for enclosing most, if not all, of the elements described above.

Frame assembly 11 is preferably made of metal, such as magnesium or zinc. Frame assembly 11 preferably has a substantially horizontal planar support 11C, a substantially vertical post 11P connected to planar support 11C, and support section 11S for receiving and/or supporting several components. Preferably, support portion 11S receives and supports diode assembly 12 and/or level vials 16, 17.

Battery B may be disposed between planar support 11C and support portion 11S. Battery B may be a 9 volt battery.

As mentioned above, diode assembly 12 may be disposed into support portion 11S. Preferably, diode assembly 12 has a laser diode (not shown) and/or a collimating lens (not shown). The laser diode and/or the collimating lens may be disposed in a barrel 12B.

A projection lens 13 may be disposed in front of the laser diode and/or the diode assembly 12. Preferably, lens 13 is substantially cylindrical, so that it can receive the light from the laser diode and project it in the shape of a fan.

Barrel 12B may have slots 12S for receiving pins 13P protruding from cylindrical lens 13. Persons skilled in the art will recognize that cylindrical lens 13 may be mounted unto barrel 12B and/or support portion 11S using other means. The diode assembly 12 and the cylindrical lens 13 will generate a laser light plane LP which, will generate a laser line LL on a surface S, as shown in FIG. 1.

Referring to FIGS. 2 and 3, the diode assembly 12 and cylindrical lens 13 are received within the support portion 11S of frame assembly 11. It is preferable to provide a means for adjusting the diode assembly 12 relative to frame assembly 11.

One such mechanism includes a spring 14, which is preferably captured between barrel 12B and support portion 11S, a set screw 15 threadingly engaged to support portion 11S, and pivot portion 11SP formed by part of the support portion 11S disposed between the spring 14 and set screw 15. It may be preferable to dispose a slot 12BS on barrel 12B to engage the pivot portion 11SP.

With such arrangement, when the set screw 15 is rotated, barrel 12B will preferably pivot about the pivot portion 11SP. If set screw 15 is rotated in the other direction, spring 14 will cause rotation of the barrel 12B about pivot portion 11SP.

It is preferable to provide some fixing compound, such as Loc-Tite, on set screw 15 so that, once the adjustment has been accomplished, the location of barrel 12B (and thus of diode assembly 12) will be fixed.

It is also preferable to provide potting adhesive in a number of location between barrel 12B and support portion 11S. Rapid cure adhesive may work well for such application.

In order for the user to be able to determine the relationship of light LL relative to a reference plane, it is preferable to provide level vials 16, 17 on line generating device 10. Level vial 16 is preferably disposed on frame assembly 11 so that, when line generating device 10 is substantially vertically on a vertical wall, level vial 16 will show the

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degree of verticality of line generating device **10**. Similarly, level vial **17** will be disposed on frame assembly **11** so that, when the line generating device **10** is disposed substantially horizontally against a vertical wall, level vial **17** will show the degree of horizontality of line generating device **10**. It is thus preferable to adjust the level vials **16**, **17** relative to the laser plane LP so that level vials **16**, **17** will provide an accurate reading thereof.

Referring to FIGS. **2** and **4A**, it is preferable to dispose level vial **17** on support portion **11S**. Preferably, level vial **17** will be captured between ribs **11R** on support portion **11S**. Similarly, one end of level vial **16** may be captured within ribs of **11R** disposed on support portion **11S**. In order to adjust level vial **16** relative to frame assembly **11** and/or level vial **17**, it is preferable to provide a ramp screw head **18**, which threadingly engages support portion **11S** and contacts the other end of level vial **16**. On the other side of level vial **16**, it is preferable to provide a compression plug **19**. Accordingly, by rotating ramp screw head **18**, the level vial **16** can be rotated to the appropriate position.

FIG. **4B** illustrates a different method of adjusting level vials **16**, **17**. In this embodiment, level vial **16** is captured between ribs **11R** on support portion **11S**. Level vial **17** is captured at one end by ribs **11R** as well. At the other end, the set screw **18'** is threadingly engaged to support portion **11S** and contacts one side of level vial **17**. Compression plug **19** is disposed on the other side of level vial **17**. Accordingly, the level vial **17** can be adjusted by rotating set screw **18'**.

Persons skilled in the art will recognize that it may be preferable to secure level vial **16**, **17** unto support portion **11S** with potting adhesive. Further ribs can be added if necessary.

Persons skilled in the art will recognize that level vial **17** is preferably fixed on frame assembly **11**, barrel **12B** is then adjusted and locked relative to level vial **17**, and level vial **16** is adjusted and locked relative to barrel **12B** and/or the laser plane LP. Persons skilled in the art will also recognize that level vial **16** may be fixed on frame assembly **11**, barrel **12B** is then adjusted and locked relative to level vial **16**, and level vial **17** is adjusted and locked relative to barrel **12B** and/or the laser plane LP. Preferably, such adjustments will be conducted when device **10** is placed on a substantially vertical surface.

As discussed above, frame assembly **11**, diode assembly **12** and level vial **16**, **17** are at least partially enclosed by housing **22**. Housing **22** preferably comprises two clamshell halves which define an opening **22O** for allowing the laser light plane LP to exit from housing **22**. Furthermore, housing **22** may have openings such as **17O** for allowing the user to see the level vial **16**, **17**. Preferably, the edge of the openings are such as **17OE** are beveled or inclined to maximize this ability of the level vial **16** and/or **17**.

Housing **22** may have a reference indicia **22R**, which is preferably coplanar with light plane LP.

Persons skilled in the art will recognize that it is preferable to dispose any electronics necessary to power the laser diode are preferably disposed on printed circuit board **20**. For example, a switch **21** may be disposed on the printed circuit board **20** for controlling the flow of power to the laser diode. A switch actuator **25** may be disposed on housing **22** for actuating switch **21**, allowing the user to turn the laser diode (and thus the line generating device **10**) on and/or off.

Referring to FIGS. **2** and **5**, a magnet **24** may be placed and glued onto a magnet holder **23**, which is preferably disposed on the planar support **11C** of frame assembly **11**. Preferably, housing **22** does not cover magnet **24**. Persons

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skilled in the art will recognize that providing magnet **24** will enable the user to dispose device **10** onto a ferrous surface, etc.

Referring to FIGS. **2** and **5–6**, line generating device **10** is preferably used with a pin assembly **30**. Pin assembly **30** may include a body **31**, a metal plate **32** disposed in body **31** and a pin **33** connected to body **31**. Preferably, pin **33** is attached to pivoting body **35**, which is in turn pivotally attached to body **31**. With such construction, pin **33** can be extended into a position where it can be inserted into drywall or retracted into a folded position within main body **31**, as shown in FIG. **6** in solid and broken lines, respectively.

Persons skilled in the art will recognize that at least one of the pivoting body **35** and body **31** will have a small protrusion (not shown) engaging a hole or notch (not shown) in the other of the pivoting body **35** and body **31**, in effect providing a detent for maintaining the pin **33** in the extended and/or retracted positions. Persons skilled in the art will know how to design such detent so that it maintains the pin **33** in the extended position when the user is inserting pin **33** into drywall. Persons skilled in the art will also know how to design such detent so that it allows pin **33** to move into the folded position when pin assembly **30** is dropped unto the floor, etc.

Housing **22** may have flanges **22F** which engage the inside of main body **31**. Alternatively, pin assembly **30** may be disposed on housing **22** and held in place via the magnetic relationship between magnet **24** and metal plate **32**. Persons skilled in the art will recognize that magnet **24** may be disposed on the pin assembly **30** and metal plate may be disposed on housing **22**.

With such arrangement, the user can dispose line generating device on a wall by inserting pin assembly **30** into the wall and then disposing line generating device **10** on pin assembly **30**. It may be preferable to provide a flat portion **34** on pin **33** to prevent the pin **33** (and thus pin assembly **30**) from rotating when inserted into drywall, etc.

It is preferable that the pin **33** be coplanar with laser light plane LP. Persons skilled in the art may recognize that, due to this coplanarity, reference indicia **22R** will also be coplanar with pin **33**. Furthermore, housing **22** may have reference indicia **22PR** which is coplanar with pin **33** along a plane which is substantially perpendicular with laser light plane LP.

This is because the user can dispose line generating device **10** on a wall or surface to mark a first line laser line, rotate line generating device **10** about pin **33** to a second position and mark a second laser line on surface S. Then when line generating device **10** and pin assembly **30** are removed, the user will be able to determine where the two laser lines meet by locating the hole created in surface S by pin **33**.

It may be preferable to provide a friction means on the wall side of main body **31** to reduce the chance of rotation of main body **31** relative to the wall. Such friction means could include rubber buttons, adhesive disks etc.

FIG. **7** illustrates another embodiment of the pin assembly **30**, where like numbers refer to like parts. Persons skilled in the art will recognize that the teachings of the previous embodiment are hereby incorporated by reference.

As before, pin assembly **30** may include a body **31** and a pin **33** connected to body **31**. Preferably, pin **33** is attached to pivoting body **35**, which is in turn pivotally attached to body **31**. With such construction, pin **33** can be extended into a position where it can be inserted into drywall or retracted into a folded position within main body **31**, as shown in FIG. **7** in solid and broken lines, respectively.

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Pivoting body 35 may be made of a ferrous material, so that it can be attracted by magnet 24, and thus pin assembly 30 is magnetically attached to device 10. Pivoting body 35 may also have a surface 35S, which contacts ledge 31L of body 31, to limit the angular movement range of pivoting body 35. Persons skilled in the art will recognize that it is preferable to ensure that surface 35S and ledge 31L contact when pin 33 is extended in the desired position.

Pivoting body 35 may also have a surface 35F which, when pin 33 is in the folded position, is adjacent and/or contacting magnet 24. This allows the user to maintain pin assembly 30 on device 10 even when pin 33 is in the folded position.

Pin assembly 30 may also have a magnet 37 on body 31. Pin 33 is preferably made of a ferrous material, and thus can be attracted to magnet 37. Accordingly, magnet 37 can maintain pin 33 in the folded position.

Referring to FIG. 8, device 10 can also be disposed on a wall mounting assembly 40. Preferably, wall mounting assembly 40 includes a main body 41. Main body 41 may receive at least two (preferably three) L-shaped legs 42, which would extend through a hole 41H in main body 41. A coil spring or collar 43 preferably maintains legs 42 together.

Main body 41 may have posts 41P and/or slots 41S in walls 41C, which receive legs 42 and prevent legs 42 from rotating about hole 41H.

Wall mounting assembly 40 may also include a cam ring 45. Cam ring 45 may have at least two (preferably three) inclined slots 45S, which each slot 45S receiving one leg 42.

Cam ring 45 may also have a plate 44. Plate 44 is preferably made of a ferrous material, so that it can be attracted to magnet 24, thus keeping wall mounting assembly 40 in contact with device 10. Plate 44 may also have a substantially spherical portion 44S, which preferably contacts the bends of legs 42. Persons skilled in the art will recognize that spherical portion 44 need not be integral to plate 44 and can thus be a separate element, such as a ball.

Cam ring 45 is preferably disposed unto main body 41. Accordingly, cam ring 45 may have a ledge 45L which is engaged by hooks 41SH of main body 41 for retaining cam ring 45. Preferably, hooks 41 are relatively resilient so that they act as snap hooks. Persons skilled in the art will recognize that ledge 45L and hooks 41SH could also be disposed on main body 41 and cam ring 45, respectively.

Cam ring 45 may also have at least one knob 45K to allow the user to rotate cam ring 45 relative to main body 41.

Persons skilled in the art will recognize that cam ring 45 can be rotated to move legs 42 from a retracted position (shown in solid lines in FIG. 8C) to an expanded position (shown in broken lines in FIG. 8C). This would allow the user to drill a hole in a wall, install the wall mounting assembly 40 unto the wall, and dispose device 10 unto wall mounting assembly 40 for operation. Due to the expanding movement of legs 42, the dimensions of the hole is not critical.

As the user rotates cam ring 45 relative to main body 41, the inclined slots 45S lift the legs 42 in an axial direction. In other words, the legs 42 move along inclined slots and towards spherical portion 44S. Spherical portion 44S in turn provides a central force at or near the bends of legs 42. The force is provided equally to each leg 42. Because legs 42 cannot rotate about the axial direction due to the posts 41P and/or slots 41S, legs 42 rotate towards the expanded position. As torque on the cam ring 45 is increased, the gripping force of legs 42 in the expanded position is

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increased. Persons skilled in the art will recognize that the user need only rotate cam ring 45 in the opposite direction in order to move legs 42 towards the retracted position.

It is preferable to provide some mechanism for maintaining legs 42 in the expanded position. Slot 45S may be provided with protrusions 45SP along the length of each slot. These protrusions 45SP define valleys 45SV where each leg 42 can remain until leg 42 is moved over the next protrusion 45SP and towards the next valley 45SV.

Persons skilled in the art will recognize that the shape of hole 41H may be designed to limit the rotational movement about the hole 41H. Accordingly, hole 41H may have slots extending from the center of the hole 41H, as shown in FIG. 8D.

Persons skilled in the art may recognize that wall mounting assembly 40 may not just be mounted to a wall, but could be mounted unto other surfaces, such as a power tool housing, etc.

While the invention has been described in this specification and illustrated in the drawings with reference to a preferred embodiment it would be understood by those skilled in the art that various changes may be made and equivalence may be substituted for elements thereof without departing for the scope of the invention as defined in the claims. In addition, many modifications may be made to a particular situation a material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment illustrated by the drawings and described by the specification as the best mode presently contemplated for carrying out this invention, but that the invention will include any embodiments falling within the foregoing description and the appended claims.

What is claimed is:

1. A line generating device comprising:

a housing;

a support assembly mounted within the housing;

a light source mounted on the support assembly;

a lens mounted on at least one of the support assembly and the light source, the lens receiving light and projecting the light in the shape of a fan within a plane;

a first level vial mounted on the support assembly, wherein the first level vial is coplanar or perpendicular to the plane; and

a magnet mounted on the support assembly.

2. The device of claim 1, further comprising a second level vial substantially perpendicular to the first level vial.

3. The device of claim 2, wherein one of the first and second level vials is adjustable relative to the other of the first and second level vials.

4. The device of claim 2, wherein the second level vial is mounted on the support assembly.

5. The device of claim 4, wherein a compression plug is disposed between the support assembly and one of the first and second level vials.

6. The device of claim 1, further comprising a pin assembly comprising a body, a metal portion disposed in the body and a pin connected to the body.

7. The device of claim 6, wherein the pin has a flat portion.

8. The device of claim 6, wherein the metal portion is pivotally attached to the body, and the pin is attached to the metal portion, the pin being movable between a retracted position and an extended position.

9. The device of claim 8, further comprising a pin magnet disposed on the body for magnetically engaging the pin in the retracted position.

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10. The device of claim **6**, wherein, when the pin assembly is connected to the housing, the pin is coplanar with the plane.

11. The device of claim **6**, wherein, when the pin assembly is connected to the housing, the pin is disposed at the intersection of the plane and a center plane bisecting the housing and being substantially perpendicular with the plane.

12. The device of claim **6**, wherein the magnet magnetically engages with the metal portion.

13. The device of claim **1**, further comprising a mount assembly comprising:

a body having a first hole;

at least two L-shaped legs extending through the first hole, the legs being bound together and being rotationally fixed by features on the body;

a cam ring disposed on the body, the cam ring having at least two inclined slots for correspondingly receiving the at least two legs, and a force member for putting force on the at least two legs.

14. The device of claim **13**, wherein the mount assembly further comprises a metal portion disposed on the cam ring for magnetically engaging the magnet.

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15. The device of claim **13**, wherein one of the inclined slots has protrusions disposed along the length of the slot.

16. The device of claim **13**, wherein the force member is a ball bearing.

17. A mount assembly comprising:

a body having a first hole;

at least two L-shaped legs extending through the first hole, the legs being bound together and being rotationally fixed by features on the body;

a cam ring disposed on the body, the cam ring having at least two inclined slots for correspondingly receiving the at least two legs, and a force member for putting force on the at least two legs.

18. The mount assembly of claim **17**, wherein the mount assembly further comprises a metal portion disposed on the cam ring.

19. The mount assembly of claim **17**, wherein one of the inclined slots has protrusions disposed along the length of the slot.

20. The mount assembly of claim **17**, wherein the force member is a ball bearing.

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